A structural analysis of a regional economy using Social Accounting Matrices: 1990-1999*

M. Carmen Lima
Universidad Pablo de Olavide de Sevilla

M. Alejandro Cardenete
Universidad Pablo de Olavide de Sevilla & centrA

José Vallés Ferrer
Universidad de Sevilla

G.J.D. Hewings
Regional Economics Applications Laboratory, University of Illinois at Urbana-Champaign

ABSTRACT

Social accounting matrices (SAM) are an instrument that enlarges the information provided by the input-output analysis. These matrices study the intersectoral relationships of an economy, the behaviour of consumers, the public sector or the foreign sector, as long as they complete the income flow of rent. In this work, we use the SAM for Andalusia (region southern Spain) 1990, 1995 and 1999, to conduct a structural analysis of the andalusian economy by means of "path analysis" methodology and multiplier decomposition. With these techniques, we obtain the changes in productive structure and we quantify the influence of sectoral shocks on this regional economy. Finally, we also identify which sectors have most strongly contributed to regional economic activity in the last decade.

Keywords: ***social accounting matrix, regional accounting, structural analysis.***

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correspondence to: M. Alejandro Cardenete
Department of Economy and Business
Universidad Pablo de Olavide at Seville
Ctra. Utrera, km.1
41013-Sevilla, Spain
Phone number: +(34) 954349181. Fax number: +(34)954349339
e-mail: macarflo@dee.upo.es

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1. Introduction.

Social accounting matrices (SAM) are databases comprising economic transactions which allow us to extract information on the different economic agents such as producers, consumers, the government and the foreign sector; as well as on the behaviour of productive factors. They complete the information provided by the input-output analysis, whose limitations have been deeply discussed in the literature[1], with the regional or national accounting and the surveys of family constraints, among other databases.

The interest on SAMs is based on the fact that not only do they study the production relationships among the economic sectors but also the transactions that take place among the different institutions of an economic system in terms of revenues or consumption. Besides their statistical content, which enables us to close the circular flow of rent, the SAMs have became a useful tool for evaluation of interventions from the political economy in national or regional frameworks.

If a SAM is available for more than one year, it is feasible to carry out a complete analysis of the productive structure of the economy and also to obtain a perspective of the changes that have occurred. Several methodologies are able to outline such analysis in a particular economy. In section two, we present a methodology based on a three-dimensional landscape[2] called "structural path analysis". Through this methodology, we can extract the main tendencies in the behaviour of an economy and we can also develop its corresponding structural view. For this purpose, we derive a hierarchy of the economy by way of the calculation of two types of indexes: the "absorption effects" or forward linkages and the "diffusion effects" or backward linkages.

In section three we analyse interdependences and decompose the backward and forward linkages in *own, open and circular effects* following a classical multiplier decomposition. In section four we include an employment multiplier because we consider that this real variable will provide valuable information in terms of elasticity between economic activity

[1] See in this respect Roland-Holst, D.W. (1990).

[2] For more details, see Hewings, G.J.D., Sonis, M. et al. (1997), or Sonis, M. et al. (1997), about the economies of Chicago and Indonesia respectively.

and capacity of employment creation. In section five, we come up with an empirical application of both methodologies on the SAMs for Andalusia in the years 1990 and 1995, elaborated in previous works[3]. We will also present a first approach for the SAM for Andalusia 1999[4]. This exercise will point out the key sectors of the regional economy, the type of interrelationships and the nature of linkages inside it. Having these multipliers for three different databases, we can extract conclusions for each year, and get a perspective of the evolution along the whole period. Finally, we outline the main conclusions.

2. Methodology: Structural Path Analysis and Multiplier Product Matrix.

The SAM accounts are divided in two blocks: exogenous and endogenous. The classification in one group or another will depend on the aspects that are to be studied. In this type of linear general equilibrium models, it is possible from a mathematical point of view, to consider all the variables except one as endogenous variables (those whose rent level or production we want to explain). Nevertheless, it is not very realistic to build a model without recognizing as exogenous those variables that are determined outside of the productive system, or those that are used as instruments of the political economy (such as taxes, subsidies, transfers, public expenses,...) since in fact, the changes in these ones will determine the behaviour of the endogenous variables.

To carry out the structural analysis of an economy, and to know what type of linkages work inside it, we should observe the changes in the intermediate flow levels among sectors. Following Hewings and Sonis (1997), we use an instrument to study the interrelationships of an economy by means of the calculation of a "Multiplier Product Matrix" (MPM), which we get from a SAM multipliers matrix.

If we reorder sectoral relationships according to their importance, we can analyse how a change in the final demand of a sector, affects the final demand of the economy (diffusion

[3] See Cardenete, M.A. (1998), and Cardenete, M.A. and Moniche, L. (2001), respectively.

[4] This first version has been calculated by the application of an updating technique called CEM (*Cross Entropy Method*) on the SAM for Andalusia 1995, carried out by Cardenete, M.A. and Sancho, F. (2002). Using this methodology, we can introduce known information inside the cells of the estimated SAM (*prior information*), letting us to use it for structural analysis because there are changes in the technical coefficients (see Robinson et al. (2001))

effect or backward linkage). We can also interpret how a change in the rest of sectors influences one in particular (absorption effect or forward linkage). These effects provide a clear orientation about the key sectors in the growth of an economy. They are useful to design performances about political economy as well, as they are supported by their high multiplier effect and the important influence of such interventions.

To analyse the sectoral interdependences in an economy, we calculate the Multiplier Product Matrix, MPM, starting from the average tendency matrix of the SAM. We identify these matrices by a subindex, *t*, according to the base year (A_{90}, A_{95} and A_{99} in this case). These matrices have been calculated by dividing every SAM column vector by the corresponding sum of that column, being *n* the number of endogenous variables (the productive sectors, the production factors and the consumers).We calculate the associate inverse matrix $B_t = (I - A_t)^{-1}$, being *I* an $n \times n$ identity matrix. The sub-indexes *i, j* make reference respectively to the rows and columns of the corresponding matrices. Following the path analysis methodology, we derive two vectors of multipliers, where each element corresponds to the sum of a column or a row respectively:

$$B_{.j} = \sum_{i=1}^{n} b_{ij} \qquad j = 1...n \qquad (1)$$

$$B_{i.} = \sum_{j=1}^{n} b_{ij} \qquad i = 1...n \qquad (2)$$

being b_{ij} components of the associated inverse matrix B_t.

Next we define the Multiplier Product Matrix as the product of the row and the column multipliers corrected by a factor that we call "global intensity" (V), which corresponds to the sum of all the elements of the associate inverse matrix:

$$MPM = \frac{1}{V} \| \; B_{i.} B_{.j} \; \| \qquad i, j = 1...n \qquad (3)$$

where

$$V = \sum_{i=1}^{n} \sum_{j=1}^{n} b_{ij} \tag{4}$$

This new matrix will identify those sectors whose structural connections generate a higher impact than the average upon the rest of the economy, whether they experience a change in their own sector or as an answer to changes detected in the rest of the system. Rasmussen (1956) and Hirschman (1958) classify these sectors as "key sectors." In short they include two indexes:

- Diffusion effect or backward linkage, *BLj*:

$$BL_j = \frac{B_{.j}}{\frac{1}{n} V} \qquad j = 1...n \tag{5}$$

- Absorption effect or forward linkage, *FLi*:

$$FL_i = \frac{B_{i.}}{\frac{1}{n} V} \qquad i = 1...n \tag{6}$$

The interpretation of these coefficients is as follows: if the backward linkage is greater than 1 (*BLj* greater than 100% in percentage terms), a unit change in the final demand of sector *j* will generate an increase above the average in the global activity of the economy. If the forward linkage is greater than 1 (*FLi* greater than 100% in percentage terms), a unit change in all the sectors of the final demand will generate an increment above the average in sector *i*. A key sector is the one with both indexes greater than one.

3. Classical multiplier decomposition in Social Accounting Matrices.

The present paper is located into the multisectoral linear models, in which we assume the exogeneity of prices. We work with three databases corresponding to three SAMs for Andalusia. We consider as endogenous those accounts that are part of the economic interrelations determined outside of the economic system (production factors, productive

sectors and private sector); while the exogenous ones are tools for the political economy (as the public sector, foreign sector and capital)[5].

The multiplier decomposition was initially proposed by Stone (1978) and Pyatt and Round (1979). Later on, Defourney and Thorbecke (1984) and again Pyatt and Round (1985) have been working on it. We also have spanish references as Polo, Roland-Holst and Sancho (1991), among others. It is also interesting to highlight the works from the regional point of view developed by Cardenete and Sancho (2003) for Andalusia, de Miguel, Manresa and Ramajo (1999) for Extremadura or Llop and Manresa (2003) for Catalonia.

The formulation of these linear models of general equilibrium is as follows:

Let y_n be:

$$y_n = \left(I - A_n\right)^{-1} \cdot x = Ma \cdot x \qquad (1)$$

where y_n is the column vector of total rent of the endogenous accounts, I is an identity matrix of order n x n, An is the average tendency matrix of expenditure between the different endogenous accounts and x is the vector that collects the flows of rent that the endogenous accounts receive from the exogenous ones.

A generic element of An as a_{ij} is interpreted as the expense carried out in i for each unit of expense of the sector j. Ma is the so called Accounting Multipliers Matrix and an element ma_{ij} indicates the effect that an exogenous unit of rent on an endogenous account j, generates on the rent of the endogenous account i. In other words, the interpretation would be how many monetary units of rent are generated in sector i because of the circular flow of rent when sector j receives a unitary shock. If we sum up these values of Ma by columns, we get the total effect of an exogenous shock received by one account on the rest of the economic activity. This way, the account with the greatest multiplier value points out one sector with an important influence on the rest of the economy when it is involved in an economic development policy.

[5] Revising the literature, there are alternative classifications, for example the ones proposed by Polo, C., Roland-Holst, D. and Sancho, F. (1991) that endogenizes the capital account, or Llop, M. and Manresa, A. (2003) with a foreign sector endogenization.

The multiplier decomposition can be carried out in two ways: additive or multiplicative. Both of them allow us to split the process of generation of rents in an economy. In this work we use the multiplicative procedure, which distinguishes among the own effects, open effects and lastly, circular effects. To start with, we outline the structure of the SAM that we are using. In our endogenous accounts we find the two productive factors (capital and labour –accounts (11) and (12), respectively-), the private sector represented by the consumers (13) and finally ten activity sectors (accounts (1) to (10)). Our exogenous accounts, following the most common approaches in the literature are three: public sector (14), savings and investment (15) , and foreign sector (16).

Following Pyatt and Round (1979), we have decomposed the matrix of accounting multipliers in other three matrices by means of a multiplicative expression. The first matrix is called *matrix of circular effects* (M_{a3}) and reflects the effect that an exogenous injection of rent generates on the very account due to the circular flow of the rent. The second matrix is known as the *matrix of open or crossed effects* (M_{a2}), and the elements of its main diagonal are identity submatrices. It shows the effects on the rest of accounts of a shock received by one particular account. Finally, we have the *matrix of own or internal effects* (M_{a1}), also known as matrix of transfers because the first element of the main diagonal is an identity submatrix (there are no transfers among the productive factors), the second shows the transactions among institutions and the later includes the interindustrial transactions, and is in fact the inverse of Leontief.

To interpret the multiplicative decomposition in terms of relative importance of each element on the total effect, we can express it in an additive form as:

$$Ma = I + (Ma_1 - I) + (Ma_2 - I)Ma_1 + (Ma_3 - I)Ma_2Ma_1 \qquad (2)$$

In the previous expression, the identity matrix allows to discount the initial injection of rent of each of the effects, so that we work with a net multiplicative decomposition.

4. Employment Multipliers.

Moreover it is possible to calculate one more multiplier to extract the accounts that generate more employment when receiving a unitary exogenous injection of rent. The *employment multipliers* are the result, in the first place, of a new diagonal matrix that we call *E*. This matrix includes the quotients between the volume of employment and the total resources for each productive sector. In the second place, we multiply this matrix with the part of *Ma* that incorporates the rows and columns corresponding to the productive sectors (in our case the order of this matrix is *10x13*). When increasing the rent of an endogenous account, we will obtain the effects of this change in the corresponding column of the partition of *Ma* and, by means of the diagonal matrix *E*, we convert this impact into number of jobs. This way the expression of the *employment multiplier*, *Me*, is the following:

$$Me = E * Ma \tag{3}$$

An element me_{ij}, is the increment in the volume of employment of the sector *i* when the sector *j* receives a unitary exogenous injection[6]. If we analyse the sum of columns, we have the effect on the employment at a global level, which entails the reception of an exogenous monetary unit on a particular sector. As far as rows is concerned, they show the increment that the activity sector in question experiences in its employment if the rest of sectors receive the exogenous monetary unit. As we are dealing with very small figures in absolute terms, we proceed to the normalization of the multipliers based on the average values by row and column and total average value. We get the new results by following these steps:

- We calculate the columns and row average values.
- We derive the total average value by means of the sum of all the values of *Me* divided by the number of elements of *Me*.
- We divide the average values by rows and columns by the total average value. If the result is greater than 1, the normalized figure indicates an employment multiplier over the average.

[6] Additional information about the employment multiplier and a comparison with other type of multipliers, is provided in Arango (1979).

This process enables us to carry out comparisons that can be easily interpreted. Accordingly, they can be used as a reference to contrast if a value is greater than what we consider an average reaction or not. Thereby, we get a classification of sectors that are able to transform its activity increments into new employment.

5. Empirical application.

5.1 Structural Path analysis: backward and forward linkages

After MPM calculations for the three databases, we reach a classification following the definition of key sectors, by means of the analysis of the backward and forward linkages. We can select those cases in which an over-average reaction is expected for the whole economy due to a modification in a sector demand, or as a consequence of a demand change in the rest of the economy.

The greatest forward linkage value in percentage terms is 312.50% for 1990 and it corresponds to "Consumers (13)". The one for backward linkages is 125.50% for "Commercial services (9)". Applying the MPM matrix, the greatest coefficient is precisely located in (13,9) position[7]. We can reorder the MPM so that the highest multipliers are located in the main diagonal in order to obtain a graphical representation of the MPM with this new sorting.

In Table 1, the backward and forward linkages have been calculated for 1990, 1995 and 1999 from the greater to the smaller values. In order to analyse the information from an aggregate point of view, we present one three-dimensional graphic –landscape-, for each period. These landscapes are drawn with the previously mentioned reordering for an easier comparison between one period and another.

In the three *landscapes* in the Appendix at the end of the work, we observe an activity reduction in 1995 and a recovery that slightly exceeds the initial situation of 1990. These

[7] MPM calculation has not been included in the paper in order to avoid a wider Appendix, any consultation will be attended.

results show the better behaviour of the andalusian economy for the last SAM corresponding to 1999, on account of the recovery from the crisis of the first years of the nineties.

Table 1: Backward and forward linkages 1990, 1995 y 1999 (in percentage terms).

ANDALUSIA 1990						ANDALUSIA 1995						ANDALUSIA 1999					
Backward linkages BLj ranking			Forward linkages Fli ranking			Backward linkages BLj ranking			Forward linkages Fli ranking			Backward linkages BLj ranking			Forward linkages Fli ranking		
1st	9	125.50%	1st	13	312.50%	1st	9	129.02%	1st	13	318.90%	1st	9	136.53%	1st	13	367.74%
2nd	8	121.86%	2nd	4	177.23%	2nd	6	121.17%	2nd	12	186.13%	2nd	10	126.49%	2nd	12	215.08%
3rd	11	113.45%	3rd	12	152.34%	3rd	10	120.10%	3rd	4	151.09%	3rd	6	123.83%	3rd	11	126.81%
4th	12	113.45%	4th	11	139.55%	4th	8	114.63%	4th	11	148.80%	4th	11	121.14%	4th	6	108.21%
5th	10	109.59%	5th	6	117.87%	5th	5	113.63%	5th	6	119.61%	5th	12	121.14%	5th	8	96.61%
6th	1	108.00%	6th	8	81.00%	6th	12	111.46%	6th	8	73.00%	6th	5	108.21%	6th	9	81.73%
7th	5	107.40%	7th	7	65.03%	7th	7	102.14%	7th	9	59.80%	7th	3	103.43%	7th	4	71.70%
8th	7	101.33%	8th	2	58.28%	8th	3	100.74%	8th	7	55.16%	8th	8	101.36%	8th	3	51.50%
9th	6	95.44%	9th	1	51.17%	9th	1	100.45%	9th	3	50.21%	9th	13	95.29%	9th	7	51.41%
10th	13	92.84%	10th	9	49.85%	10th	13	88.86%	10th	1	44.39%	10th	7	94.09%	10th	1	35.78%
11th	3	84.91%	11th	3	42.79%	11th	11	88.39%	11th	2	35.83%	11th	1	92.77%	11th	5	31.79%
12th	4	72.78%	12th	5	31.57%	12th	4	70.78%	12th	*5*	33.38%	12th	2	40.67%	12th	*2*	31.63%
13th	2	53.45%	13th	10	20.82%	13th	2	38.63%	13th	10	23.70%	13th	4	35.06%	13th	10	30.02%

Source: Own elaboration through SAMs for Andalusia 1990, 1995 and 1999.

Note the meaning of key sector using the case of the "Capital (12)" in 1990 as an example. By consulting Table 1, we can see that one change in the final demand of this sector generates an increase in the activity of the economy, that is, the rest of the sectors get a 13% above the expected average reaction. This fact means that when capital increases in the andalusian economy, it generates a pulling effect in the rest of sectors even above its own experienced shock. This is called "diffusion effect" or backward linkage. As for the "absorption effect" or forward linkage, a change of one unit in the final demand of all the sectors produces an increase of the "Capital (12)" activity of more than 52%; again above the average. We could conclude that capital strongly reacts in moments of economic good-behaviour and, it is also pushed by the rest of sectors to a larger extend than the average reaction.

As the two previous behaviours are greater than 100%, the "Capital (12)" account is classified as a key sector for the andalusian economy in 1990. Other key sectors for this year are "Labour(11)" and "Consumers (13)" (although its "diffusion effect" did not exactly reach 100%, we consider that 92.84% is a high enough percentage, specially when the sector presents the highest "absorption effect" with a triple reaction over the expected

average when reacting to an increase in the rest of activity sectors). Finally, "Commerce (6)" also registers a similar behaviour to the consumers.

In 1995 the figures for "Capital (12)" and "Commerce (6)" remain among the relevant sectors in terms of generation of economic activity. "Consumers (13)" are taken out as a key sector because, although they show an even higher absorption effect than in 1990 (close to 318.90%), they continue the decreasing tendency of the diffusion effect of the previous period. A similar process appears in the "Labour (11)" sector.

In 1999, we highlight the growth of the "diffusion effect" and "absorption effect" in the "Capital (12)" account that strongly behaves as a key sector for the andalusian economy. "Labour (11)" recaptures its position of 1990 as a key sector, and "Commerce (6)" consolidates its place as a key sector. "Consumers (13)" recover positions ending up improving their capacity to influence the rest of sectors through increases in demand. They also increase their capacity to take advantage of the expansion moments reflected in increments in the final demand of the rest of sectors. Finally, "Other services (8)" joins the group of growth accelerators sectors in this region.

We will now study those sectors that, although they do not behave as key sectors because they register a low forward linkage value, they certainly do have a great capacity to accelerate economic activity when they experience a change in their own final demand, that is to say, they have a high "diffusion effect" or backward linkage. Such is the case of "Commercial services (9)", with the highest value in this category, and "Other Services (8)" in 1990; once again "Commercial services (9)" and "Non Commercial services (10)" in 1995; and, finally for 1999, "Commercial services (9)" which repeats again, conforming its position as a sector of high "diffusion effect" for the whole decade- We get the same behaviour for "Non Commercial services (10)" in 1995. These data show the high relevance of services in the andalusian economy, once we have confirmed the important influence of a demand increment both in private and public services, on the rest of activity sectors.

If we focus on the sectors that exert the least impulse on activity when they experience an increase on their final demand, that is, those that are not able to transmit their growth to the rest because of their low "diffusion effect". We can highlight the "Extractives (2)" and the

"Manufacturing industry (4)" for the three years. We would like to point out that the first sector keeps a specially marked downward tendency in 1995 which is still present in 1999. The "Manufacturing industry (4)" which registered a 27% below average, also experiencing a drastic fall in the early nineties, concluding with an "diffusion effect" of only 35.06%, the smallest value among those registered in 1999. With this result we see the reduced capacity of the secondary sector to reactivate the andalusian economy.

Regarding the evolution along time of the sectors that generate important backward linkages, the decade shows that "Commercial services (9)"(where housing sector services and machinery renting are included) is in the first position throughout the whole time. This behaviour confirms that housing sector has a huge capacity to impulse the rest of andalusian activity sectors along the nineties. "Other Services (8)" (financial intermediation services, insurance services and pensions), move from second position at the beginning of the nineties, to fourth place in 1995 and finishes the decade in eighth place, being an example of continuous descent. A similar behaviour is observed as for "Agriculture, Cattle & Forestry and Fishing (1)". The opposite case is true for "Commerce (6)", which begins in ninth position, getting second place by the middle of the nineties and reaching the top positions in 1999. We highlight the volatility of the "Labour (11)" sector that moves from third place in 1990 to eleventh position in 1995, returning to the lead in the ranking at the end of the period. The other sectors remain relatively stable.

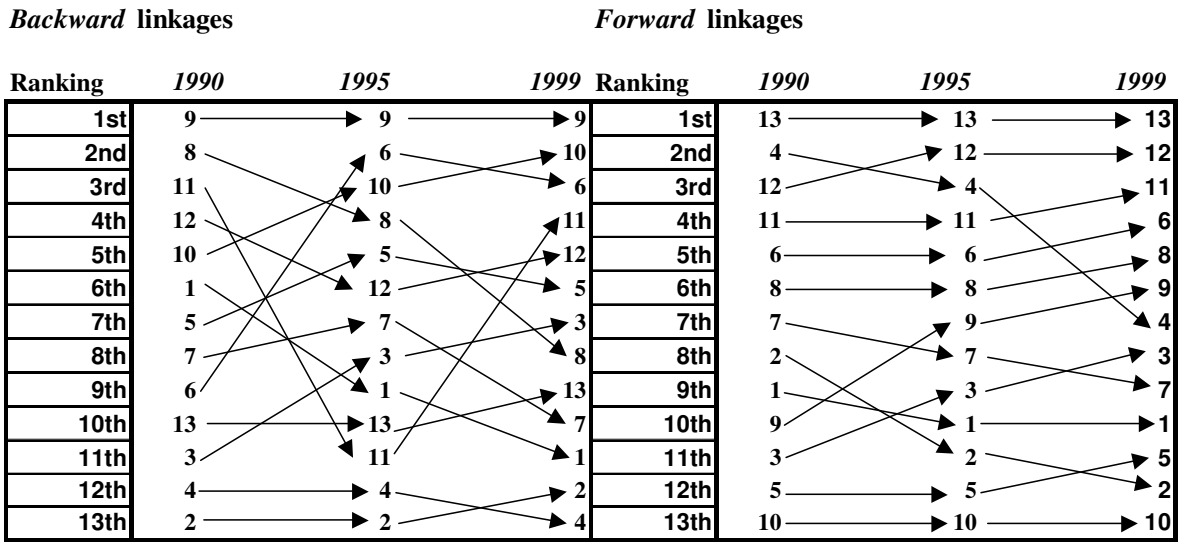
Consider those sectors which, although they do not behave as real key sectors, they are very elastic to increases in the final demand of the rest of activity sectors. Such is the case of the "Manufacturing industry (4)" and "Commerce (6)" in 1990 and the "Manufacturing industry (4)" again and "Labour (11)"in 1995. Finally, in 1999, the "Manufacturing industry (4)" changes its behaviour, going to seventh place in the ranking of the "absorption effects", showing a short reaction at the end of the decade. This means that 1999 is an inflection point for the andalusian industry, since "absorption effect" decrease from 151.09% to a modest 71.70%.

If we consider the sectors with a low "absorption effect", we encounter "Non-Commercial services (10)" and "Construction (5)" for 1990 and for 1995, although the third and fourth positions are different for those years: "Electricity and Natural Gas (3)" and "Commercial services (9)" in 1990 and "Extractives (2)" with "Agriculture, Cattle & Forestry and

Fishing (1)" for 1995. With regard to 1999, the sectors are the same ones as in the preceding period.

If we follow the evolution along time of forward linkages in order to establish a similar hierarchy as that with the backward linkages, we conclude that the first position is for "Consumers (13)", which triplicates the so-called average reaction. Between 1990 and 1995 there are no significant position changes, but we must highlight the rise of "Commercial services (9)" that change from the tenth to seventh place. Between 1995 and 1999, this sector is stabilized to the middle of the ranking. There are no more relevant changes.

Figure 1: Evolution of activity sectors in Andalusia: 1990-99.



Source: Own elaboration through SAMs for Andalusia for 1990, 1995 and 1999.

From the empirical results shown in this section, we have enough information to describe structural behaviours of andalusian economy. We can outline that it bases its growth on investment and commerce for the decade of the nineties. These two sectors, together with the influence of consumption and labour factor at the beginning and at the end of the period, are the most dynamic accounts because of their high diffusion and absorption effects. These results present an economy with a limited secondary sector that is not able to generate an economic expansion even when it registers and exogenous positive shock. This rigidity seems to be the result of a political economy focused on services, and specially on tourism.

5.2 Multipliers for andalusian economy.

By applying the previous theoretical analysis on the SAM of Andalusia, we have obtained four types of multipliers: those that measure the own, open, circular effects, and finally, the ones of employment. These multipliers from SAMs incorporate all the flows that take place between the institutions and the productive sectors (the induced effects if we carry out an additive multiplier decomposition or the circular effects if we follow the terminology of the multiplicative one[8]).

If we proceed to decompose the multipliers for andalusian economy throughout the nineties, we can derive some general results for the three databases used. One of them is that the effects that register a bigger weight in relation to the others, are the circular ones, followed by the open effects and lastly by the own effects. There is a single exception to the leadership of the circular effects, namely, labour factor and consumers; in this case, the order of importance between circular and open effects is inverted. This fact is similar to the case of the capital factor, although slightly softer.

We can learn from this behaviour that our regional economy is very dynamic in the sense that it registers high sectoral interaction values derived from the circular flow of rent and from the effect of one monetary unit demand change in a sector on the rest of sectors. These rich multiplier effects are very useful when taking economic policy decisions because we can previously assess collateral impacts of a sector change on the rest of the economy.

From a global perspective of the decade, the multipliers measured at added level reach the highest values in 1990, with a descending tendency up to 1999 (this one is next to 60% in some cases). We can observe how a widespread decrease has taken place since 1990. The highest value for 1995 is 17.70% of decrement of the circular net effects. This descent is even stressed in 1999, when there is an outstanding fall of the own net effects (it almost reaches 60%), followed by the circular ones with more than 25%. Finally, the open net effects are not so affected (13.03%). In general the data show a reduction in terms of total effects so that the variation rate is doubled from one period to the other. From this general

[8] For a better comprehension of this aspect, see Boch, J. et alia (1997).

behaviour we detect a progressive *cooling down* of the economy probably as a consequence of the crisis in the middle of the nineties, situation that keeps on till the end of the decade.

If we analyse the aggregate multipliers for 1990, it shows the general behaviour where the circular effects have a high weight that surpasses 40% of the total net effects at the worst, and at best they represent more than 60% ("Extractives (2)" and "Commercial services (9)" respectively). The next ones are the open net effects that vary around 30% with the exceptions of the productive factors whose data are considerably bigger, and the "Extractives (2)" whose value is smaller than the average. Finally, we have the own net effects with an the oscillation band of 5.14% for "Commercial services (9)" in the lower bound and again the "Extractives (2)" in the upper one with 35.05%.

It is interesting the homogeneous behaviour of the sectors corresponding to "Agriculture, Cattle & Forestry and Fishing (1)", "Construction (5)" and all services in general (from accounts (5) to (10)) with the mentioned exceptions. Another example of similar behaviour is that of the productive factors and the private sector (from account (11) to (13)), while a third block corresponds to the industrial sectors (from (3) and (4)). Lastly, we have the outlier value of "Extractives (2)".

Looking the results of the multiplier decomposition for 1990 by rows, the biggest values are registered by productive factors together with the private sector. It is also important the role played by the open effects for these three accounts, while the own effects grow in the rest and the open effects fall.

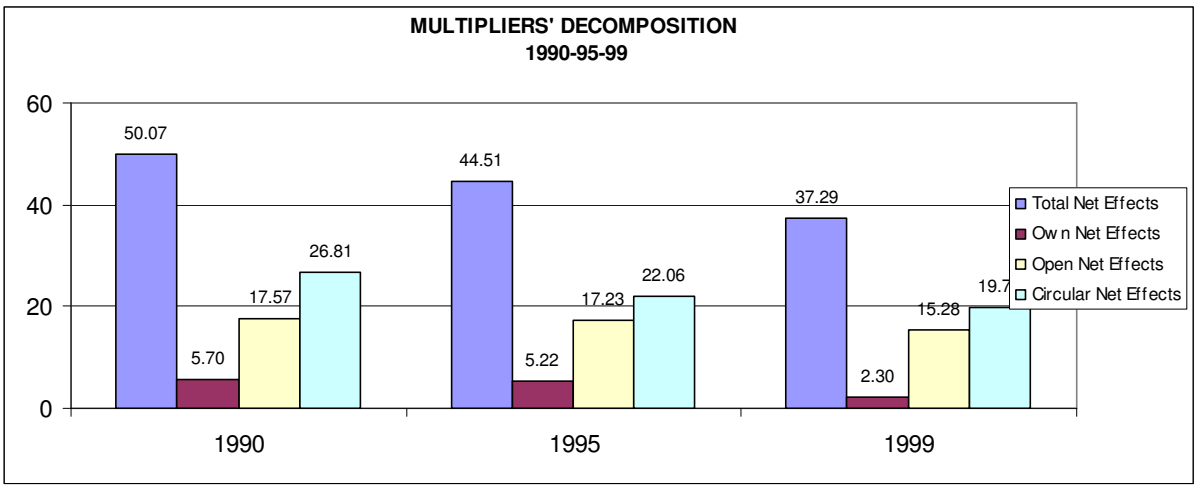
For 1995, the circular net effects continue at the top although they register a lower value with respect to the previous year. In spite of this, they explain more than 50% of the total effect in most of the accounts, showing the important feedback of an exogenous shock. The open effects also consolidate positions while the own net effects present a stationary behaviour in the accounts (1), (3), and (4) and a reduction in the rest. In relation to these last effects, we verify that their value is 0 for the productive factors and the private sector as we had previously argued.

As far as rows is concerned, the circular effects are smaller, with some cases of reduction of the multiplier like in "Construction (5)" where there is a fall of more than 50%. The open net effects are also smaller than in columns while the own net effects grow in most of the cases.

In the third year of analysis, again the circular net effects are the greatest ones as it happened in the other years. The open effects grow lightly with the exception of the accounts of the productive factors and consumers. Similar behaviours for both diffusion and absorption effects are reflected in 1999.

So as to be able to compare the multipliers by means of a temporary analysis, we have elaborated a group of figures where the different effects are analysed:

Figure 2: Comparison of the total, own, open and circular net effects for Andalusia in the nineties.

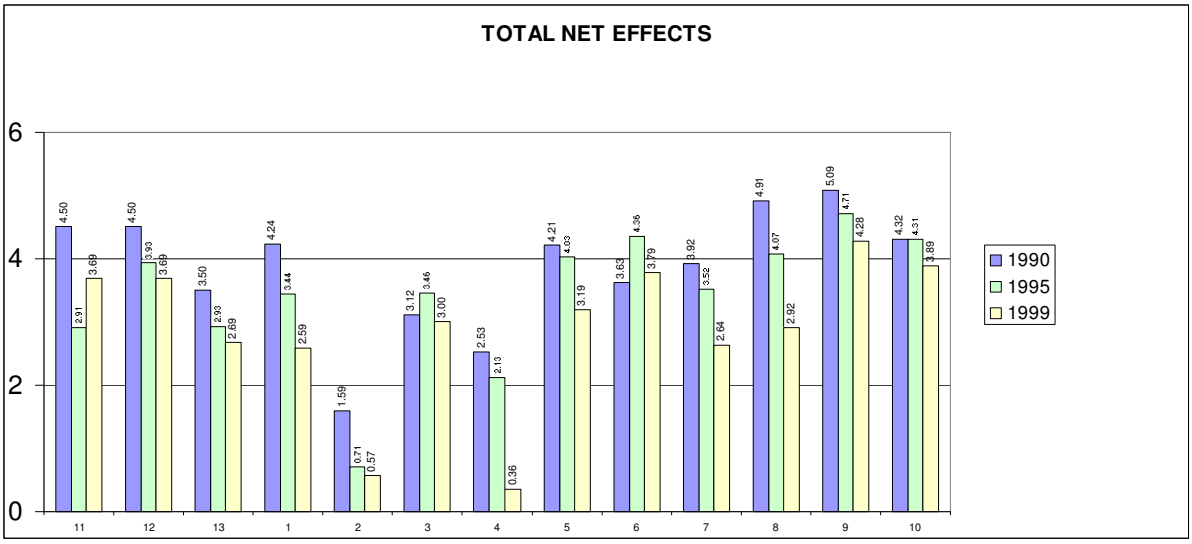


Source: Own elaboration starting from the SAM of Andalusia 1990-95-99.

As we observe in Figure 2, the highest multipliers both in absolute terms and in disaggregated level, are those of 1990. This shows a bigger activity of the economy before a monetary injection comes from any of the exogenous accounts. We explain this behaviour with the huge investment that took place for the Word Fair *Expo'92*. In fact, we can affirm that this event helped to reduce the main limitations for andalusian growth at the end of the eighties: the lack of physical infrastructure.

In Figure 3 we carry out a comparative analysis of each block of total net effects through a bars diagram. In this graph we find a certain harmony in the accounts with bigger total effects all through the decade. Those accounts are the “Commercial services (9)”, “Non Commercial services (10)” and “Capital (12)". Only for “Commerce (6)”, the total effects of 1995 are able to go above those of 1990. Lastly, it is interesting to analyse the important fall in the total effects for some sectors in 1999, for example “Manufacturing industry (4)" or “Extractives (2)”, which was a common behaviour in the rest of accounts with the exception of "Labour (11)".

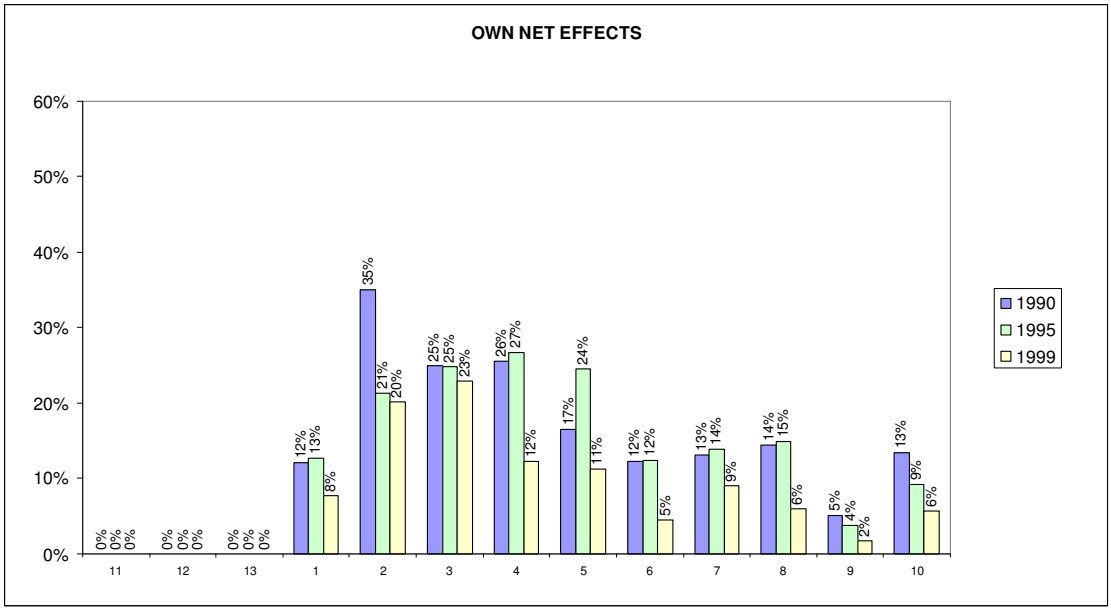
Figure 3: Total net effects for Andalusia along the nineties.



Source: Own elaboration starting from the SAM of Andalusia 1990-95-99.

The own net effects only take values for the accounts corresponding to the activity sectors, showing a descending tendency with the exception of the “Construction (5)”. This account increases from 16.54% to 24.46%, and falls in the last year up to 11.25%.

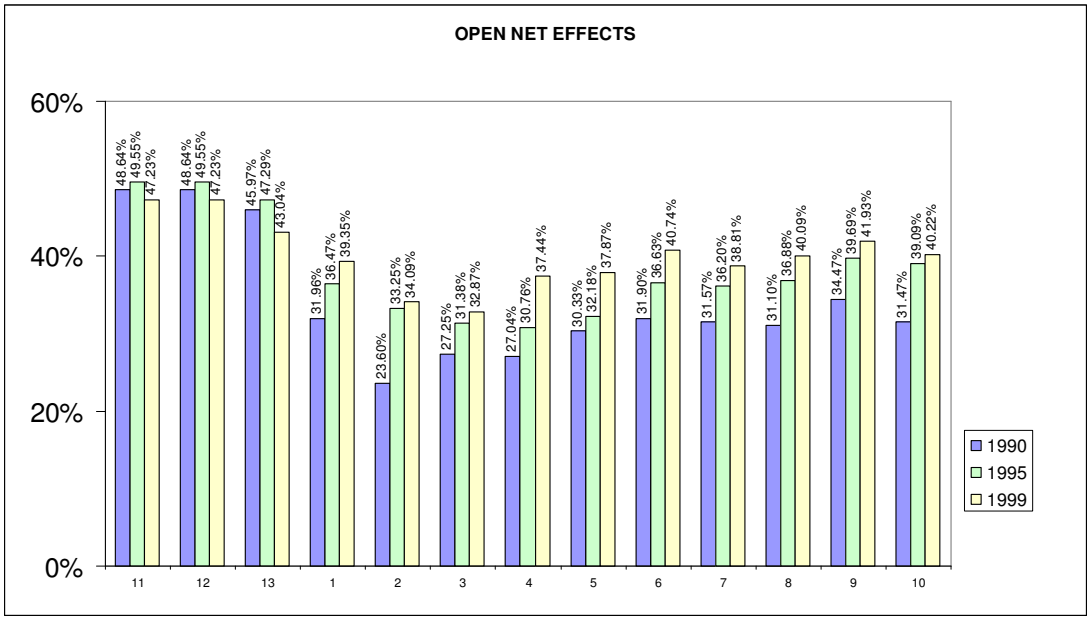
Figure 4: Own net effects for Andalusia along the nineties.



Source: Own elaboration starting from the SAM of Andalusia 1990-95-99.

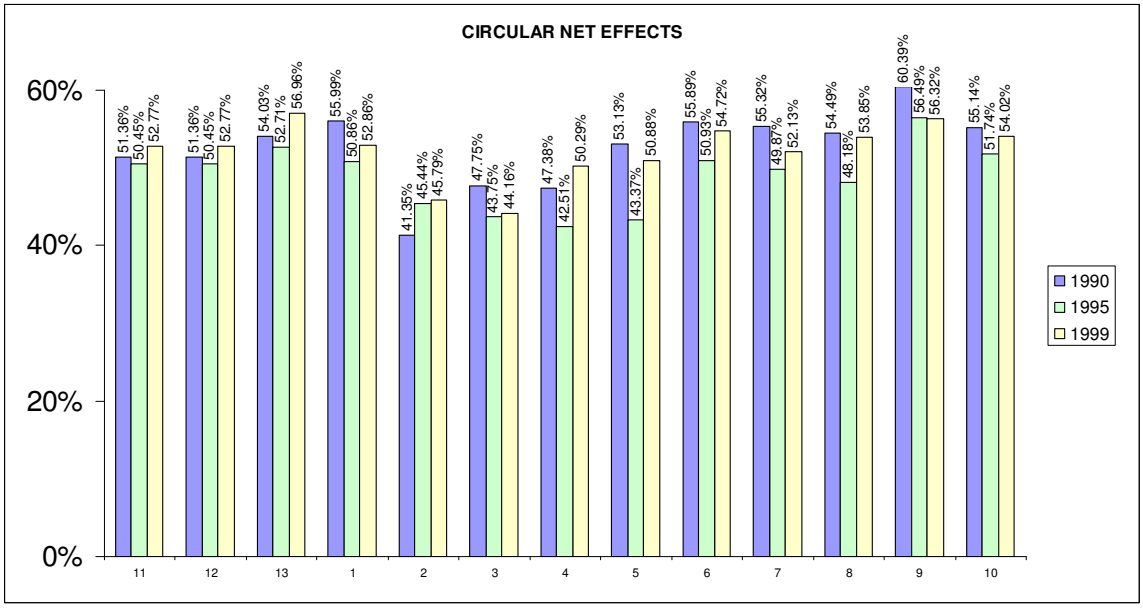
The open net effects register a very homogeneous behaviour during the whole decade, growing steadily from 1990 to 1999. The productive factors and the private sector behave different from the rest, with higher values for the whole period. The circular effects remain stable between 40% and 60%, and the highest multipliers correspond to services and specially to "Commercial services" (6).

Figure 5: Open net effects for Andalusia along the nineties.



Source: Own elaboration starting from the SAM of Andalusia 1990-95-99.

Figure 6: Circular net effects for Andalusia along the nineties.



Source: Own elaboration starting from the SAM of Andalusia 1990-95-99.

Working on different endogeneity criteria is an interesting exercise to deepen in the relative weight of the mentioned interdependences. Although this is not the object of the present work, we can conclude that whenever we include one more endogenous sector in the analysis, the immediate result is an increment in the value of the multipliers. This is because more variables are part of the feedback flow.

We present now the employment multipliers for andalusian economy. From the column analysis we see that the effect on employment of the reception of a monetary unit coming from an exogenous account. Therefore, by means of the revision of the data given by the sum of rows, we can test the increase experienced in the employment of each activity sector after a positive shock on the final demand of the economy.

The present employment multipliers have been normalized by columns and rows. This is very relevant because they can be compared in relation to the average of the sector and with regard to the total average of sectors. As we already explained in the previous section, it has been necessary to build a diagonal matrix for every year to obtain the figure of employment in relation to the total output of the sector.

Table A.1 shows the multipliers for 1990. We observe that the accounts with a bigger capacity to generate employment are ”Agriculture, Cattle & Forestry and Fishing (1)", "Construction (5)", “Commerce (6)", “Commercial services (9)" and “Non Commercial services (10)". As we can see, these sectors also registered high values in the previous multiplier decomposition, but there are also some new accounts like the primary sector or the construction. All these sectors react over the average in terms of employment creation when receiving an exogenous shock in their own final demand.

The rows show us that the accounts (1), (6), (9) and (10) react generating new employment as a consequence of an increment of the final demand. We can use the terminology of key sectors for the employment creation in those sectors that show a bigger employment-activity elasticity from the demand or offer point of view. The "Construction (5)" is taken out of this block of sectors and “Manufacturing industry (6)" seems to be more receptive in moments of good economic activity, which will entail the creation of new employment.

Table A.2, presents the employment multipliers corresponding to 1995. Reading the figures of the columns, we find again the accounts of the precedent year with the exception of “Construction (5)" which registers a soft slope that locates it below the average reaction. Revising the data by rows, we find the same accounts of 1990. The employment generation capacity of “Commercial services (9)" with 2.7 times the average reaction, is only surpassed by “Commerce (6)". If in 1990 the “Manufacturing industry (4)” registered values below our reference, during this year the situation becomes even worse.

Finally, Table A.3 comprises the employment multipliers for 1999. To begin with the columns, the sectors that, when receiving an increment in their final demand of a monetary unit, are able to impulse the employment in the rest of activity sectors; are the same ones than in 1995. However, there is a new incorporation that can suppose an important change for Andalusian economic activity. For the first time in the decade of the nineties, the account of “Manufacturing industry (4)” experiences a change that makes it join the group of activity sectors that produce new figures of employment.

As for rows, there are three accounts that are greater than the established standard and register multipliers greater than one: on the one hand “Commerce (6)" together with “Commercial services (9)" which is strengthened as a key sector in terms of employment,

and on the other hand the “Manufacturing industry (4)" that doubles the average. This way, the sector (4) is a key account for the employment creation in 1999 and we also consider it as a key sector for regional economic planning.

Following the evolution of the employment multipliers in the decade, we can summarize such information in Table 2 and Table 3:

Table 2: Employment multipliers for Andalusia in the nineties. Column analysis.

	1	2	3	4	5	6	7	8	9	10
1990	1.542	0.222	0.468	0.553	1.057	1.202	0.769	0.842	1.278	2.936
1995	1.275	0.294	0.521	0.485	0.813	1.278	0.921	0.860	2.026	2.662
1999	1.317	0.575	0.573	1.021	0.891	1.496	0.834	0.753	1.612	1.566
Δ 1995/90	*-17%*	*33%*	*11%*	*-12%*	*-23%*	*6%*	*20%*	*2%*	*59%*	*-9%*
Δ 1999/90	*-15%*	*159%*	*23%*	*85%*	*-16%*	*24%*	*9%*	*-11%*	*26%*	*-47%*

Source: Own elaboration starting from calculation of the multipliers of employment 1990-95-99.

Table 3: Employment multipliers for Andalusia in the decade of the nineties. Row analysis.

	1	2	3	4	5	6	7	8	9	10
1990	1.699	0.049	0.109	0.805	0.517	2.907	0.555	0.456	1.102	1.800
1995	1.101	0.213	0.092	0.539	0.219	2.323	0.665	0.548	2.711	1.587
1999	0.823	0.413	0.060	1.999	0.191	2.552	0.460	0.644	2.107	0.750
Δ 1995/90	*-35%*	*334%*	*-15%*	*-33%*	*-58%*	*-20%*	*20%*	*20%*	*146%*	*-12%*
Δ 1999/90	*-52%*	*740%*	*-45%*	*148%*	*-63%*	*-12%*	*-17%*	*41%*	*91%*	*-58%*

Source: Own elaboration starting from calculation of the multipliers of employment 1990-95-99.

We have calculated some variation rates from 1990 to 1995 and from 1990 to 1999, so we establish a comparison of the situation from the beginning of the period until the end of the period. We found very heterogeneous behaviours, for example the important growth experienced by “Extractives (2)" which is followed by “Manufacturing industry (4)" although if we observe the data in detail, the take off of this multiplier remains stable from 1995 onwards. The rest of accounts register a moderate growth between 10% and 25%. Such is the case of (3), (6), (7) and (9). The most significant fall is a 47% of “Commercial services"(10).

In relation to the evolution by rows, again we highlight the “Extractives (2)", followed by the “Manufacturing industry (4)" and the “Commercial services (9)". Similar reductions

take place in the multipliers of the primary sector, the energy production, the construction or the non commercial services.

To summarize with, we have found relevant information from these multipliers. Firstly, there is one sector that behaves as a key sector both in terms of backward and forward linkages and employment. That is the case of "Commerce (6)". Any political decision focused on increasing the final demand of this sector is supported by a very good reaction in terms of activity and employment in the decade of the nineties. There is no doubt that regional government has taken advantage of this opportunity, probably setting aside some structural reforms that could have improved the poor reaction of industrial sectors in terms of generation of value added.

We have found a very stable group of sectors responsible for employment generation in the rest of the economy: the private and public services. Once again our results describe andalusian economy as a region where service activities monopolize the higher percentage of generation of rent and employment.

We have also detected that the nice figures in terms of employment multipliers have became better all along the period, probably induced by a more flexible labour market framework that could be partially responsible for a more elastic behaviour of accounts like "Manufacturing industry (4)".

6. Conclusions.

The goal of combining fields of industrial concentration with a development strategy which takes advantage of the endogenous character of each region and its dynamics[9], compels us to study those sectors that are able to generate growth and distribute the added value in a national or regional economy.

[10] For more information see Curbelo, J.M. (1988).

In this work we have outlined a structural analysis of the andalusian economy using Social Accounting Matrices. The temporal scenario considered was the decade of the nineties, and we have used the SAMs for the years 1990, 1995 and a first version for 1999.

From the "structural path analysis" methodology, we extract a graphical representation of a "three-dimensional landscape" that captures the structure of relationships among the productive sectors of the andalusian economy. These linkages provide information to analyse the effect of a change in the final demand of a sector on the whole andalusian economy or to measure the influence of the expansion of one sector on the rest of them. All the necessary information has been collected in the backward linkages or "diffusion effects" and forward linkages or "absorption effects".

Moreover, the results obtained for the andalusian economy show that the productive factors, the consumers account and some commercial sectors, generate important multiplier effects on economic activity all through the decade, with the very small exceptions. From 1995 on, growth-employment elasticity decreased considerably (the labour factor was displaced to third place at the end of the ranking as regards generation of "diffusion effects" in this year). It is also important to remark that "Construction (5)" stayed between seventh and fifth positions during the whole decade as regards the "diffusion effect", demonstrating its capacity as an stimulator of economic activity.

It is important to outline that the "Manufacturing industry (4)" is unable to work as a developer of economic activity on the andalusian economy, ending up the decade with a very limited capacity of influence on the rest of sectors, even in moments when manufacturing demand increased. This weakness is even more remarkable if we keep in mind that its reaction in moments of optimal behaviour of the rest of the sectors becomes worser as time goes by. Such behaviour restricts the effectiveness of certain investment policies, due to the apparent rigidity of the secondary sector.

As for services, they show a high "absorption effect" in the whole period. This result was expected in this research due to the weight of this sector in the andalusian economy. We must point out the good behaviour of "Commercial services" (9) as well as "Non-Commercial services"(10) or public services. The sector with an exemplary capacity to

generate added value is the one of "Commerce (6)", which includes tourist activities, since it is able to register huge linkages in both senses.

In this work we have also introduced a methodology of classic multiplier decomposition from SAMs, by means of a multiplicative disaggregation that separates the net effects of an initial shock in own, open and circular effects. The use of the SAM enables us to complete the information derived from Leontief technology, and quantify the importance of the feedback effects generated by the own circular flow of rent. In relation to the multiplier decomposition, we have come across with a fall of the total effects of 25% in the whole decade (the own net effects and the circular effects ended up registering a reduction of 60%). We have also noticed that in spite of this falling evolution, the circular effects keep the greater values, which proves the importance of the feedback that is taking place in the andalusian economy.

Furthermore, we have completed the analysis of multipliers with a fourth multiplier in terms of creation of new jobs. Later we have carried out an empiric application obtaining the corresponding multipliers for the three representative years of the decade of the nineties: 1990, 1995 and 1999. The results show the reaction of the private sector, the government or the savings and investments when facing a change in the final demand. We have also found interesting answers in relation to the elasticity of each of the productive sectors as for their capacity to generate employment. The employment key sectors are those that react generating employment above the average value when they receive an exogenous injection or when the rest of the economy experiences the shock. Such accounts remain invariable during the decade and they are the primary sector and services in general. It is important to underline that in 1999 we detect a new dynamic account, the one of the "Manufacturing industry (4)" which for the first time becomes an employment key sector. Such a behaviour means a new stage for the secondary sector in Andalusia.

It is important to remark that, employment keysectors, do not coincide with classical multiplier decomposition keysectors and the policy maker must balance whether to push one activity sector or another. The previous result makes us think if it is reasonable to finance secondary sectors through regional policy funds like European Regional Development Fund (ERDF) or European Social Fund (ESF), specially once we have pointed out their rigidity. In fact, if we follow our previous reasoning, the region of

Andalusia, -classified as Objective 1 for the european regional policy-, should concentrate on activities able to generate a high value added, as those we have highlighted, in order to get the best results from the european support. But in this case, the regional growth model would be very dependent on a few service sectors. In this sense, we think that, with the aim of reducing future obstacles to regional development, policy makers should direct their efforts in combining actions able to capture the higher multiplier effects, with others that improved the low reaction of inelastic sectors. Such decision would probably mean a redefinition of priorities in the current regional policy. This long run bet, it would derive in changes in intervention axes of Regional Development Plans (RDP) and Community Support Framework (CSF) for 2000-06 and in the one in current negotiation for 2007-2013.

In conclusion, we consider that it is necessary to work with the results of this paper in a double sense: trying to catch up the advantages of multipliers and at the same time, designing an strategy to improve the behaviour of less dynamic accounts. Furthermore, the advantage of this work is that we can extract strengths and weaknesses of a regional economy.

Obviously, we must keep in mind that we are working with the limitations of a linear model derived from a SAM. Of course, we must interpret our results under the caution of the limitation of the statistical databases. To deepen in other aspects and to asses the impact of a political decisions – i.e. a change of the amount received of European Funds in Andalusia- in wider terms as consumer's welfare, income, GDP or price levels; we could develop a Computable General Equilibrium (CGE) model. In these models, we set a group of functional relations that describe the behaviour of different agents and then search for the corresponding solution. This more sophisticated tool would be helpful to polish the final results. CGE models advance information on the results that can be expected after an intervention, and they point out the prospective reaction of the most important regional economic linkages.

To finish with, in this work we have outlined those keysectors of an economy which can be used to analyse problems of regional planning by means of lineal general equilibrium models from SAMs. The main objective has been to study the internal arrangements within the andalusian activity sectors from an aggregate point of view, in order to determine their

potentialities and weaknesses. This type of exercise can provide with ex-ante and ex-post exercises to the object of assessing the effects of choosing certain investment projects instead of others. Decisions of this type can condition regional growth in the long term, generating *strangulations* in the productive activity if an adapted development strategy is not properly designed.

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8. Appendix.

Table A.1: Employment multipliers for Andalusia in 1990.

Accounts	1	2	3	4	5	6	7	8	9	10	11	12	13	Sum of row	Average value	Total average	Normaliz. value
1	0.950	0.023	0.049	0.116	0.095	0.092	0.080	0.094	0.099	0.087	0.108	0.108	0.108	**2.008**	**0.154**	**0.091**	***1.699***
2	0.002	0.028	0.007	0.002	0.002	0.002	0.003	0.002	0.002	0.002	0.002	0.002	0.002	**0.058**	**0.004**		***0.049***
3	0.004	0.002	0.079	0.003	0.004	0.004	0.004	0.005	0.005	0.006	0.004	0.004	0.004	**0.129**	**0.010**		***0.109***
4	0.074	0.019	0.036	0.173	0.089	0.059	0.069	0.068	0.071	0.070	0.075	0.075	0.075	**0.951**	**0.073**		***0.805***
5	0.016	0.007	0.015	0.009	0.413	0.015	0.015	0.020	0.022	0.021	0.020	0.020	0.020	**0.611**	**0.047**		***0.517***
6	0.233	0.068	0.153	0.131	0.233	0.795	0.200	0.243	0.272	0.234	0.291	0.291	0.291	**3.437**	**0.264**		***2.907***
7	0.036	0.017	0.028	0.023	0.039	0.033	0.245	0.039	0.041	0.040	0.038	0.038	0.038	**0.657**	**0.051**		***0.555***
8	0.024	0.010	0.018	0.016	0.028	0.026	0.026	0.221	0.039	0.042	0.030	0.030	0.030	**0.539**	**0.041**		***0.456***
9	0.060	0.026	0.038	0.031	0.056	0.065	0.055	0.074	0.609	0.061	0.076	0.076	0.076	**1.303**	**0.100**		***1.102***
10	0.003	0.002	0.001	0.001	0.001	0.001	0.001	0.002	0.002	2.108	0.002	0.002	0.002	**2.128**	**0.164**		***1.800***
Sum of columns	**1.402**	**0.202**	**0.426**	**0.503**	**0.961**	**1.093**	**0.699**	**0.766**	**1.162**	**2.670**	**0.646**	**0.646**	**0.646**				
Average value	**0.140**	**0.020**	**0.043**	**0.050**	**0.096**	**0.109**	**0.070**	**0.077**	**0.116**	**0.267**	**0.065**	**0.065**	**0.065**				
Total average	**0.091**																
Normalized value	***1.542***	***0.222***	***0.468***	***0.553***	***1.057***	***1.202***	***0.769***	***0.842***	***1.278***	***2.936***	***0.710***	***0.710***	***0.710***				

Source: Own elaboration through SAM for Andalusia 1990.

Table A.2.: Employment multipliers for Andalusia in 1995.

Accounts	1	2	3	4	5	6	7	8	9	10	11	12	13	Sum of row	Average value	Total average	Normaliz. value
1	0.598	0.006	0.023	0.072	0.046	0.042	0.031	0.033	0.037	0.038	0.028	0.038	0.038	**1.033**	**0.079**	**0.072**	***1.101***
2	0.004	0.130	0.023	0.009	0.007	0.004	0.003	0.004	0.004	0.004	0.003	0.004	0.004	**0.200**	**0.015**		***0.213***
3	0.003	0.001	0.060	0.002	0.002	0.003	0.002	0.003	0.003	0.003	0.002	0.002	0.002	**0.086**	**0.007**		***0.092***
4	0.036	0.007	0.024	0.106	0.058	0.041	0.033	0.034	0.036	0.033	0.026	0.036	0.036	**0.506**	**0.039**		***0.539***
5	0.004	0.001	0.002	0.001	0.171	0.004	0.002	0.003	0.004	0.005	0.002	0.003	0.003	**0.206**	**0.016**		***0.219***
6	0.131	0.024	0.105	0.068	0.131	0.584	0.137	0.138	0.179	0.160	0.141	0.191	0.191	**2.179**	**0.168**		***2.323***
7	0.023	0.010	0.023	0.019	0.033	0.042	0.313	0.028	0.030	0.028	0.020	0.027	0.027	**0.624**	**0.048**		***0.665***
8	0.019	0.005	0.021	0.014	0.024	0.032	0.025	0.226	0.031	0.041	0.021	0.028	0.028	**0.514**	**0.040**		***0.548***
9	0.099	0.027	0.092	0.057	0.110	0.166	0.114	0.147	1.135	0.166	0.116	0.157	0.157	**2.543**	**0.196**		***2.711***
10	0.004	0.001	0.003	0.002	0.003	0.004	0.003	0.006	0.005	1.444	0.004	0.005	0.005	**1.489**	**0.115**		***1.587***
Sum of columns	**0.920**	**0.212**	**0.376**	**0.350**	**0.587**	**0.922**	**0.664**	**0.621**	**1.462**	**1.921**	**0.363**	**0.491**	**0.491**				
Average value	**0.092**	**0.021**	**0.038**	**0.035**	**0.059**	**0.092**	**0.066**	**0.062**	**0.146**	**0.192**	**0.036**	**0.049**	**0.049**				
Total average value	**0.072**																
Normalized value	***1.275***	***0.294***	***0.521***	***0.485***	***0.813***	***1.278***	***0.921***	***0.860***	***2.026***	***2.662***	***0.504***	***0.680***	***0.680***				

Source: Own elaboration through SAM for Andalusia 1995.

Table A.3: Employment multipliers for Andalusia in 1999.

Accounts	1	2	3	4	5	6	7	8	9	10	11	12	13	Sum of row	Average value	Total average	Normaliz. value
1	1.157	0.004	0.020	0.013	0.026	0.035	0.021	0.024	0.037	0.039	0.040	0.040	0.040	**1.499**	**0.115**	**0.140**	***0.823***
2	0.003	0.628	0.082	0.003	0.007	0.004	0.003	0.003	0.004	0.004	0.004	0.004	0.004	**0.752**	**0.058**		***0.413***
3	0.002	0.001	0.081	0.000	0.002	0.003	0.002	0.002	0.003	0.003	0.003	0.003	0.003	**0.110**	**0.008**		***0.060***
4	0.209	0.057	0.155	1.352	0.341	0.209	0.186	0.146	0.195	0.191	0.200	0.200	0.200	**3.640**	**0.280**		***1.999***
5	0.004	0.001	0.003	0.000	0.313	0.003	0.002	0.002	0.004	0.006	0.003	0.003	0.003	**0.347**	**0.027**		***0.191***
6	0.232	0.047	0.213	0.029	0.264	1.449	0.241	0.244	0.371	0.341	0.406	0.406	0.406	**4.647**	**0.357**		***2.552***
7	0.024	0.014	0.029	0.004	0.033	0.042	0.481	0.026	0.037	0.035	0.038	0.038	0.038	**0.838**	**0.064**		***0.460***
8	0.048	0.011	0.054	0.007	0.061	0.079	0.055	0.403	0.087	0.096	0.091	0.091	0.091	**1.173**	**0.090**		***0.644***
9	0.153	0.040	0.157	0.021	0.188	0.254	0.166	0.191	1.501	0.272	0.298	0.298	0.298	**3.836**	**0.295**		***2.107***
10	0.011	0.002	0.011	0.001	0.013	0.016	0.011	0.013	0.019	1.205	0.021	0.021	0.021	**1.365**	**0.105**		***0.750***
Sum of columns	**1.844**	**0.805**	**0.803**	**1.430**	**1.248**	**2.096**	**1.169**	**1.054**	**2.257**	**2.193**	**1.102**	**1.102**	**1.102**				
Average value	**0.184**	**0.081**	**0.080**	**0.143**	**0.125**	**0.210**	**0.117**	**0.105**	**0.226**	**0.219**	**0.110**	**0.110**	**0.110**				
Total average value	**0.140**																
Normalized value	***1.317***	***0.575***	***0.573***	***1.021***	***0.891***	***1.496***	***0.834***	***0.753***	***1.612***	***1.566***	***0.787***	***0.787***	***0.787***				

Source: Own elaboration through SAM for Andalusia 1999.

Figure A.1: LANDSCAPE ANDALUSIA 1990
(numeraire)

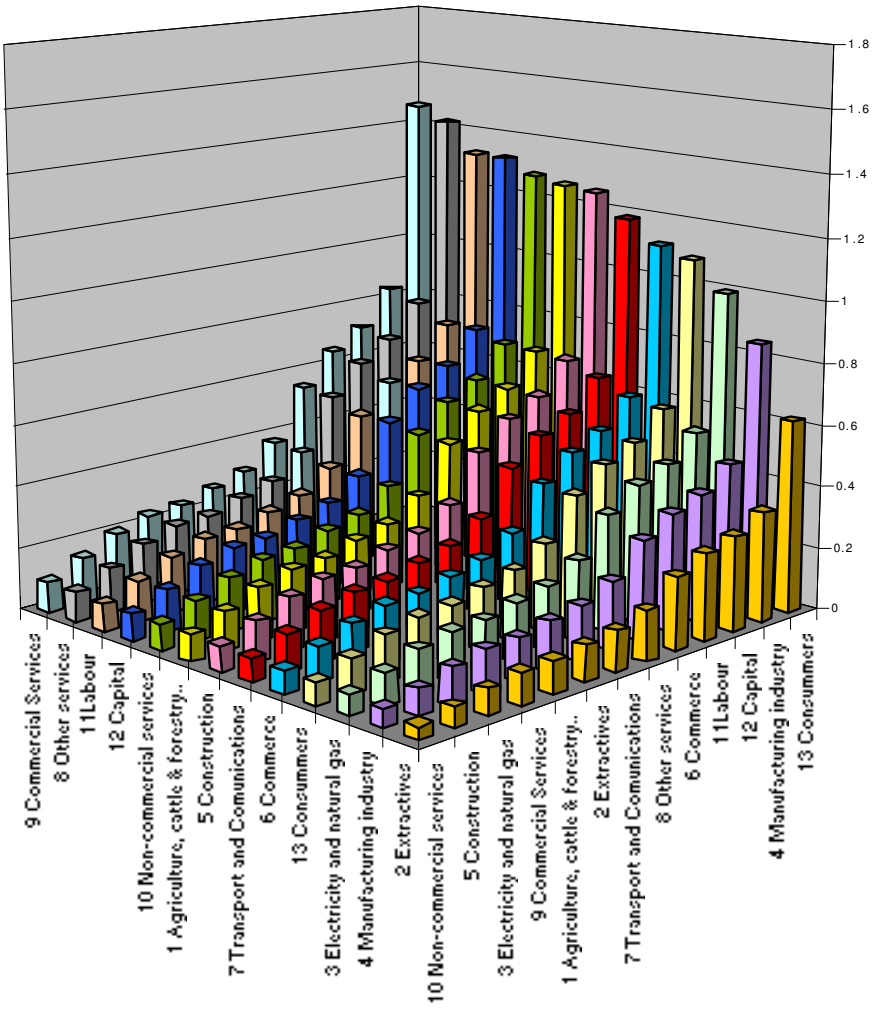

Figure A.2 LANSCAPE ANDALUSIA 1995
(numeraire 1990)

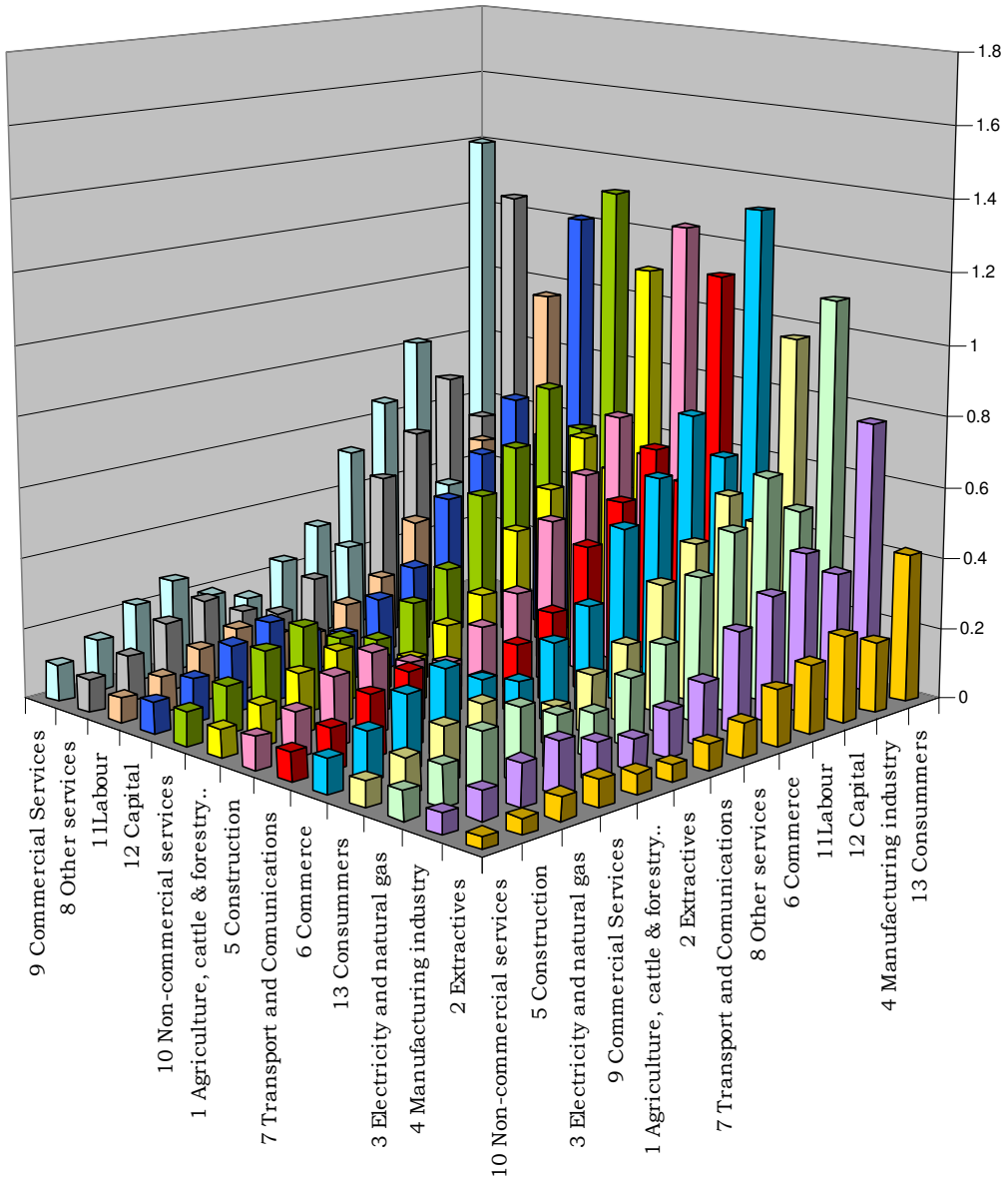

Figura A.3 LANDSCAPE ANDALUSIA 1999
(numeraire 1990)